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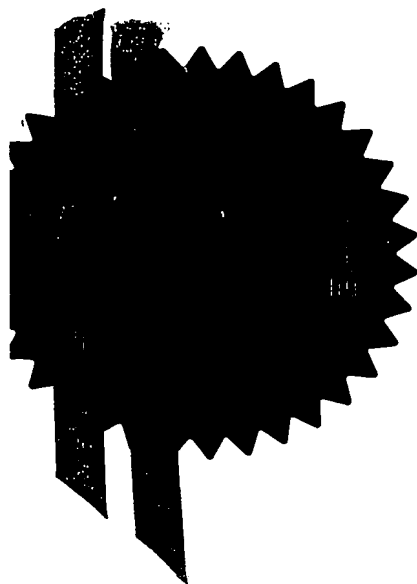
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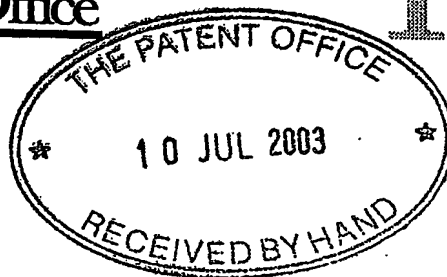
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Signed *P. Mahoney*
Dated 7 July 2004

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)



The Patent Office

Cardiff Road
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1. Your reference

REP07224GB

2. Patent application number
(The Patent Office will fill in this p

0316204.7

11JUL03 E821784-10 D02890

P01/7700 0.00-0316204.7

10 JUL 2003

3. Full name, address and postcode of the or of each applicant (underline all surnames)

Amedis Pharmaceuticals Ltd.
162 Cambridge Science Park
Milton Road
Cambridge
CB4 0GP

Patents ADP number (if you know it)

8576993001

If the applicant is a corporate body, give the country/state of its incorporation

United Kingdom

4. Title of the invention

COMPOUNDS AND THEIR USE

5. Name of your agent (if you have one)

Gill Jennings & Every

"Address for service" in the United Kingdom to which all correspondence should be sent (including the postcode)

Broadgate House
7 Eldon Street
London
EC2M 7LH

Patents ADP number (if you know it)

745002 /

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and (if you know it) the or each application number

Country

Priority application number
(if you know it)

Date of filing
(day / month / year)

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application

Date of filing
(day / month / year)

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? (Answer 'Yes' if:

YES

a) any applicant named in part 3 is not an inventor, or

b) there is an inventor who is not named as an applicant, or

c) any named applicant is a corporate body.

See note (d))

Patents Form 1/77

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Description

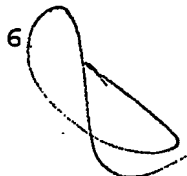
21

Claim(s)

6

Abstract

Drawing(s)



10. If you are also filing any of the following, state how many against each item.

Priority documents

Translations of priority documents

Statement of inventorship and right to grant of a patent (*Patents Form 7/77*)

Request for preliminary examination and search (*Patents Form 9/77*)

Request for substantive examination (*Patents Form 10/77*)

Any other documents
(please specify)

NO

11. For the applicant
Gill Jennings & Every

I/We request the grant of a patent on the basis of this application.

Signature

Date

10 July 2003

12. Name and daytime telephone number of person to contact in the United Kingdom

R E Perry

020 7377 1377

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Notes

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COMPOUNDS AND THEIR USE

Field of the Invention

This invention relates to compounds and their use in therapy.

Background to the Invention

5 Gonadotropin-Releasing Hormone (GnRH) plays a key role in the biology of reproduction. GnRH is also known as luteinizing hormone-releasing hormone (LH-RH).

10 The GnRH decapeptide (pyro-Glu-His-Trp-Ser-Tyr-Gly-Leu-Arg-Pro-Gly-NH₂ or p-EHWSYGLRPG-NH₂) is formed in neurons of the medial basal hypothalamus from a larger precursor via enzymatic processing. The peptide is released in a pulsatile manner into the pituitary portal circulation system, where GnRH interacts with high-affinity receptors (7-transmembrane G-protein coupled receptors) in the anterior pituitary gland located at the base of the brain. Here, GnRH triggers the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), both of which are gonadotropic hormones (gonadotropins). LH stimulates the production of testosterone and estradiol in the testes and ovaries respectively, whilst FSH stimulates follicle growth in women and sperm formation in men. When correctly functioning, the pulsatile release and concentration levels of GnRH are critical for the maintaining of gonadal steroidogenesis and for normal functions of reproduction related to growth and sexual development.

20 The pituitary response to GnRH varies greatly throughout life. GnRH and the gonadotropins first appear in the foetus at about ten weeks of gestation. Sensitivity to GnRH reduces until the onset of puberty. There is, however, a brief rise during the first three months after birth. Prior to puberty, the FSH response to GnRH is greater than that of LH. Once puberty begins, sensitivity to GnRH increases, and pulsatile LH secretion ensues. Later in puberty and throughout the reproductive years, pulsatile release of GnRH occurs throughout the day, with responsiveness to LH being greater than that of FSH. Pulsatile GnRH release results in pulsatile LH and FSH release and thus testosterone and estradiol release from the gonads. Post-menopause, the concentration of FSH and LH rise, and the post-menopausal levels of FSH are higher than those of LH.

Chronic administration of GnRH agonists and antagonists results in decreased circulating levels of both LH and FSH. GnRH agonists are compounds that mimic endogenous GnRH to stimulate receptors on the pituitary gland, resulting in release of LH and FSH. After a transient rise in gonadal hormone production ("flare" response), the chronic administration of GnRH agonists results in down-regulation of the GnRH receptors. This down-regulation and desensitization results in a reduction in the circulating levels of LH and FSH. In spite of the symptom-exacerbating hormonal flare experienced, GnRH agonists have been the preferred treatment for sex-steroid-dependent pathophysiologies. GnRH agonists have been used to reduce testosterone production, thereby reducing prostate volume in benign prostatic hyperplasia (BPH) and slowing tumour growth in prostate cancer. Such compounds have also been used in the treatment of breast and ovarian cancers.

In recent years, GnRH antagonists have become available for clinical evaluation, and have been shown to have an immediate effect on the pituitary but without the observed flare associated with agonists. Use of GnRH antagonists has been reported for the treatment of ovarian, breast and prostate cancers.

Other uses of antagonists include endometriosis (including endometriosis with pain), uterine myoma, ovarian and mammary cystic diseases (including polycystic ovarian disease), prostatic hypertrophy, amenorrhea (e.g. secondary amenorrhea), and precocious puberty. These compounds may also be useful in the symptomatic relief of premenstrual syndrome (PMS). Antagonists may also be useful to regulate the secretion of gonadotropins in male mammals to arrest spermatogenesis (e.g. as male contraceptives), and for treatment of male sex offenders. GnRH antagonists and agonists have been shown to have utility in treatments where a reversible suppression of the pituitary-gonadal axis is desired.

The presence of GnRH receptors on anterior pituitary cells and several tumour cell types offers the opportunity to develop drugs that act upon receptors to treat both hormone-dependent and hormone-independent cancers.

Conventionally, androgen deprivation has been the most effective systematic therapy for the treatment of metastatic carcinoma of the prostate. The prostate gland requires androgens for normal growth, maintenance, and function. Prostate cancer and benign prostate hyperplasia, however, are
5 common in men and develop in an environment of continuous exposure to androgen. Utilizing a GnRH antagonist to interrupt the pituitary-gonadal axis reduces androgen production and results in tumour growth modulation.

GnRH antagonists may have a direct effect on tumour growth by blocking receptors on the tumour cells. For those cancer types that respond both to sex
10 hormones and to GnRH directly, antagonists should be effective in slowing tumour growth by two mechanisms. Since GnRH receptors are present on many prostate and breast cancer cells, it has recently been proposed that GnRH antagonists may also be effective in treating non-hormone-dependent tumours. Recent literature examples indicate that GnRH receptors are present on a
15 number of cancer cell lines. In particular, prostate, ovarian and breast cancers (see for example Montagnani *et al.*, *Arch. Ital. Urol. Androl.* **1997**, *69*(4), 257-263; Jungwirth *et al.*, *Prostate* **1997**, *32*(3), 164-172; Srkalovic *et al.*, *Int. J. Oncol.* **1998**, *12*(3), 489-498; Kottler *et al.*, *Int. J. Cancer* **1997**, *71*(4), 595-599.

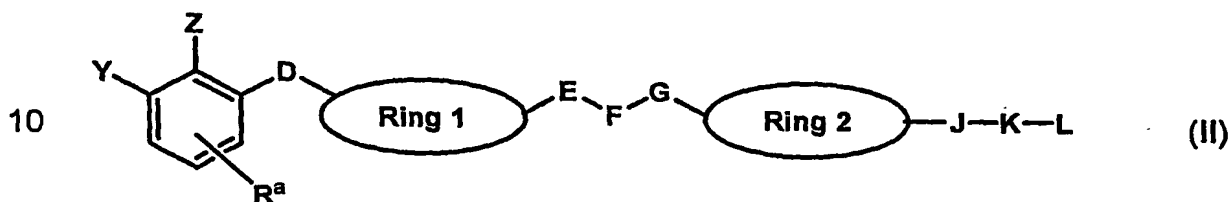
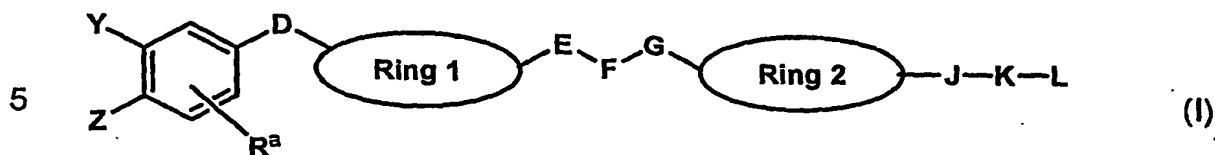
Available GnRH antagonists have primarily been peptide analogues of
20 GnRH (see, for example, WO93/03058). Peptide antagonists of peptide hormones have some potency but, the use of current peptide antagonists is often associated with problems because peptides are degraded by physiological enzymes and often poorly distributed within the organism being treated. They thus have a limited effectiveness as drugs.

25 WO00/20358 discloses non-peptide analogues of GnRH.

Sila-substitution (C/Si-exchange) of drugs is a relatively recent approach for searching for organo-silicon compounds which have beneficial biological properties. The approach involves the replacement of specific carbon atoms in compounds by silicon, and monitoring how the biological properties of the
30 compounds have changed. A review of this approach is provided in Tacke and Zilch, *Endeavour*, New Series, 10, 191-197 (1986).

Summary of the Invention

A first aspect of the invention is a compound of formula (I) or formula (II):



wherein

15 D is $-(CH_2)_n-$, $-C(=X)-$, $-O-$, $-S(O)_m-$, $-C(=X)N(R^e)-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-C(R^b)=C(R^b)-$, $-CH(R^b)CH(R^b)-$;

E is optionally present and is $-(CH_2)_n-$, $-N(R^d)-$, $-(CH_2)_nN(R^d)-$ or $-N(R^d)(CH_2)_n-$;

F is $-C(=X)-$ or $-N(R^d)-$;

20 G is $-(CH_2)_n-$, $-N(R^d)-$, $-(CH_2)_nN(R^d)-$ or $-N(R^d)(CH_2)_n-$;

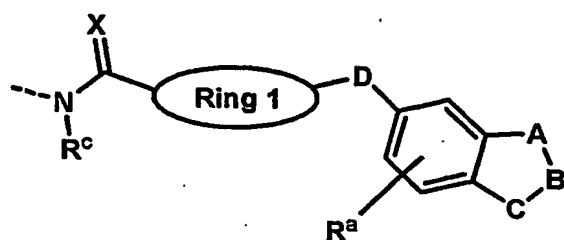
J is optionally present and is $-O-$, $-N(R^c)C(=X)-$, $-C(=X)N(R^c)-$, $-S(O)_m-$, $-N(R^c)S(O)_m-$, $-S(O)_mN(R^c)-$ or $-N(R^e)-$;

K is optionally present and is alkylene optionally substituted with R^b ; or
K is cycloalkylene, cycloalkenylene, arylene, heterocycloalkylene,
25 heterocycloalkylene or heteroarylene, any of which is optionally substituted with R^a ;

L is hydrogen, halogen, $-N(R^f)_2$, cycloalkyl, cycloalkenyl, aryl, heterocycloalkyl, heterocycloalkenyl or heteroaryl, any of which is optionally substituted with R^a , $-C(=X)OR^d$, $-OH$, $-OR^c$, $-C(=X)N(R^b)(R^c)$, $-S(O)_mN(R^b)(R^c)$ or
30 $-CN$;

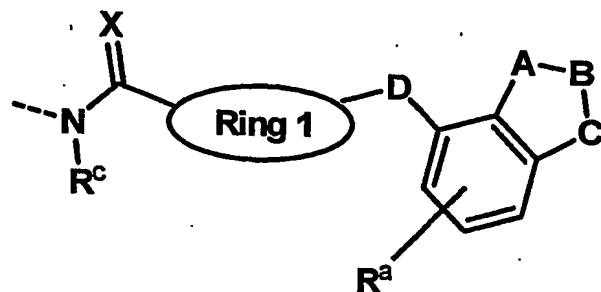
or L is a group of formula (i), (ii), (iii), or (iv)

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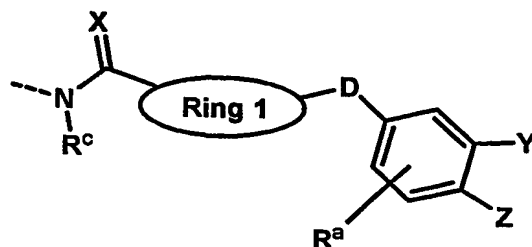
(i)

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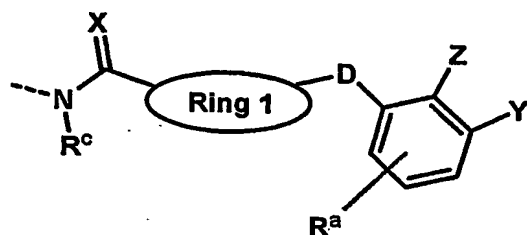
(ii)

10



(iii)

15



(iv)

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25

A and C are the same or different and are each a bond, $-(CH_2)_n-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-O-$, $-S(O)_m-$, $-N=$, $-N(R^b)-$, $-N(R^e)C(=X)-$ or $-C(=X)-$;

B is $-(CH_2)_n-$, $-O-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-C(R^b)=C(R^b)-$, $-C(R^b)=$, $-(CH_2)_nC(R^g)_2-$, $-C(R^g)_2(CH_2)_n-$ or $-CH(R^b)CH(R^b)-$;

30

wherein any of A, B and C is optionally substituted with $-Si(R^c)_3$;

N is nitrogen;

each R^a is the same or different and is hydrogen, halogen, alkyl, aryl, hydroxy, alkoxy, -alkoxy-(CH₂)_nC(O)₂R^b, -O-aryl, -C(=X)R^c, -NO₂, -CN, -N(R^c)C(=X)R^c, -C(=X)N(R^c)₂, -S(O)₂N(R^c)₂ or -N(R^e)₂;

each R^b is the same or different and is hydrogen or alkyl;

5 each R^c is the same or different and is alkyl, cycloalkyl, -alkyl-aryl, -alkyl-cycloalkyl or aryl optionally substituted with R^a;

each R^d is the same or different and is hydrogen, alkyl or aryl optionally with R^a;

10 each R^e is the same or different and is hydrogen, alkyl; or R^a is aryl or heteroaryl, either of which is optionally substituted with R^a;

each R^f is the same or different and is hydrogen or alkyl; or R^f-N-R^f taken together form heterocycloalkyl, heterocycloalkenyl or heteroaryl;

R^g-C-R^g taken together form heterocyclyl;

each X is the same or different and is oxygen or sulphur;

15 Y and Z are the same or different and are each hydrogen, halogen, alkyl, hydroxy, alkoxy, -CN, -N(R^d)C(=X)R^c, -C(=X)N(R^c)(R^d), -S(O)_m-R^c, -N(R^c)(R^d)S(O)₂, -S(O)₂N(R^c)(R^d), -N(R^e)₂, -Si(R^c)₃, -alkyl-Si(R^c)₃, aryl optionally substituted with R^a or -O-aryl optionally substituted with R^a;

20 Rings 1 and 2 are the same or different and are each arylene or heteroarylene, either of which is optionally substituted with R^a;

each m is the same or different and is 0, 1 or 2; and

each n is the same or different and is 0, 1, 2, or 3;

with the provisos that at least one of A, B, C, Y or Z comprises silicon and that the compound does not contain a Si-Si bond;

25 or a pharmaceutically acceptable salt thereof.

Compounds of the invention are GnRH antagonists and as a consequence may have utility in cancer therapy or in the treatment or prevention of endometriosis, uterine myoma, an ovarian disease, a mammary cystic disease, prostatic hypertrophy, amenorrhea, precocious puberty, premenstrual syndrome, a sex-steroid-dependent pathophysiology or benign prostatic hyperplasia, or to arrest spermatogenesis.

30

Another aspect of the invention is a pharmaceutical composition comprising a compound of the invention and a pharmaceutically acceptable diluent or carrier.

Another aspect of the invention is the use of a compound of the invention
5 for the manufacture of a medicament for cancer therapy.

Another aspect of the invention is the use of a compound of the invention for the manufacture of a medicament for the treatment or prevention of endometriosis, uterine myoma, an ovarian disease, a mammary cystic disease, prostatic hypertrophy, amenorrhea, precocious puberty, premenstrual syndrome,
10 a sex-steroid-dependent pathophysiology or benign prostatic hyperplasia, or to arrest spermatogenesis.

Description of the Invention

Certain compounds and combinations of substituents are preferred; in particular see the subclaims.

15 The term "alkyl" as used herein refers to an optionally substituted straight or branched chain alkyl moiety having from one to six carbon atoms, and includes, for example, methyl, ethyl, propyl, isopropyl, butyl, tert-butyl, pentyl, hexyl and the like. "C₁₋₆ alkyl" has the same meaning. The substituents may be the same or different in each occurrence and selected from halogen and the like.

20 "Alkylene" refers to a similar, divalent group.

The term "alkoxy" as used herein refers to an optionally substituted straight or branched chain alkoxy group containing one to six carbon atoms, and includes, for example, methoxy, ethoxy, propoxy, isopropoxy, butoxy, tert-butoxy, pentoxy, hexoxy and the like. "C₁₋₆ alkoxy" has the same meaning. The
25 substituents may be the same or different in each occurrence and selected from halogen and the like.

The term "halogen" as used herein refers to F, Cl, Br or I.

The term "aryl" as used herein refers to optionally substituted aromatic ring systems comprising six to ten ring atoms, and optionally substituted
30 polycyclic ring systems having two or more cyclic rings at least one of which is aromatic. This term includes for example, phenyl and naphthyl. The group may be optionally substituted with the substituents being the same or different in each

occurrence and selected from R^a and the like. "Arylene" refers to a similar, divalent group.

The term "cycloalkyl" as used herein refers to a saturated alicyclic moiety having from three to six carbon atoms and includes for example cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl and the like. The group may be optionally substituted by any substituent described herein. "Cycloalkylene" refers to a similar, divalent group.

The term "cycloalkenyl" as used herein refers to an alicyclic moiety having from three to six carbon atoms and having in addition at least one double bond, and includes for example cyclopentenyl, cyclohexenyl and the like. The group may be optionally substituted by any substituent described herein. "Cycloalkenylene" refers to a similar, divalent group.

The term "heterocycloalkyl" as used herein refers to a saturated heterocyclic moiety having from four to seven carbon atoms and one or more heteroatoms selected from the group N, O, S and includes for example azetidiny, pyrrolidinyl, tetrahydrofuranyl, piperidinyl and the like. The group may be optionally substituted by any substituent described herein. "Heterocycloalkylene" refers to a similar, divalent group.

The term "heteroaryl" as used herein refers to aromatic ring systems of five to ten atoms or which at least one atom is selected from O, N and S and includes for example furanyl, thiophenyl, pyridyl, indolyl, quinolyl and the like. The group may be optionally substituted with R^a and the like. "Heteroarylene" refers to a similar, divalent group.

The term "heterocyclyl" as used herein refers to a saturated or unsaturated heterocyclic ring moiety having from four to seven carbon atoms and one or more heteroatoms selected from N, O, S, P and Si, and includes, for example, piperidinyl, pyrrolidinyl, morpholinyl and the like. The group may be polycyclic (e.g. a fused ring system), the group comprising two or more rings, at least one of which comprises a heteroatom.

Preferred compounds of the invention include:

N-{[2-(phenylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(6-methoxy-4-phenoxy-3-trimethylsilylphenylthio)}furan-2-carboxamide;

N-{[2-(*N*-*tert*-butoxycarboxypiperidin-4'-amino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-5-((2,2-dimethylpropyl)dimethylsilyl)phenoxy]}furan-2-carboxamide;

5 *N*-{[2-(3-imidazolo-*N*-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-5-(1,1-dimethyl-2-trimethylsilyl)ethyl)phenoxy]}furan-2-carboxamide;

N-{[2-(2-ethylaminoethylamine)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-4-(dimethylphenylsilyl)phenoxy]}furan-2-carboxamide;

N-{(2,4,6-trimethoxyphenyl)-5-[2-(*tert*-butyldimethylsilyl)phenyloxy]}phenyl-2-carboxamide;

10 *N*-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(4-chloro-2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

15 *N*-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

20 *N*-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(4-chloro-2-methoxy-6-methyl-3-trimethylsilylphenoxy)furan-2-carboxamide.

N-(2,4,6-trimethoxyphenyl)-5-[2-methyl-(5-dimethylpropylsilyl)phenoxy]furan-2-carboxamide;

25 *N*-{[2-(3-dimethylamino-propylamino)]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-[(*N*-*tert*-butoxycarbonylpiperidin-4-yl)amino]]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(3-morpholinylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

30 *N*-[2-(3-methoxycarbonylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(3-morpholinylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(2-pyrrolidinyethylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

5 *N*-[2-(2-(ethylamino)ethylamino)]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-[*N*-(2-aminoethyl)-propylamino]]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

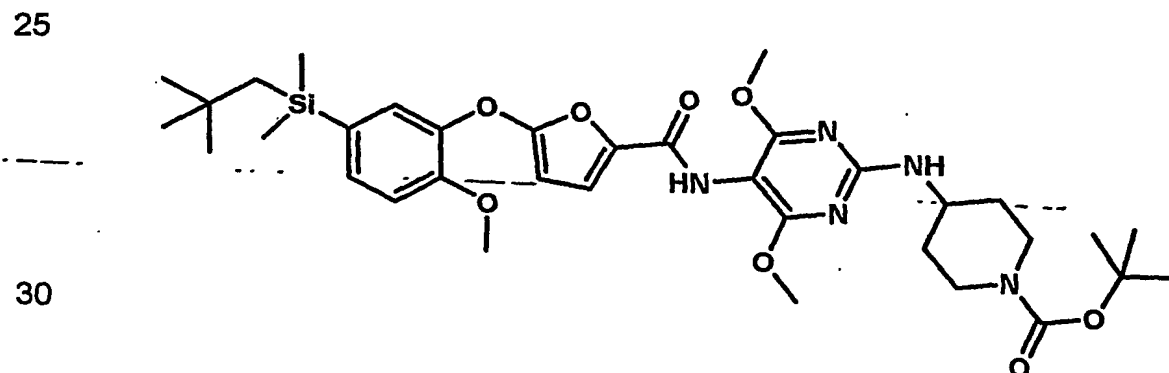
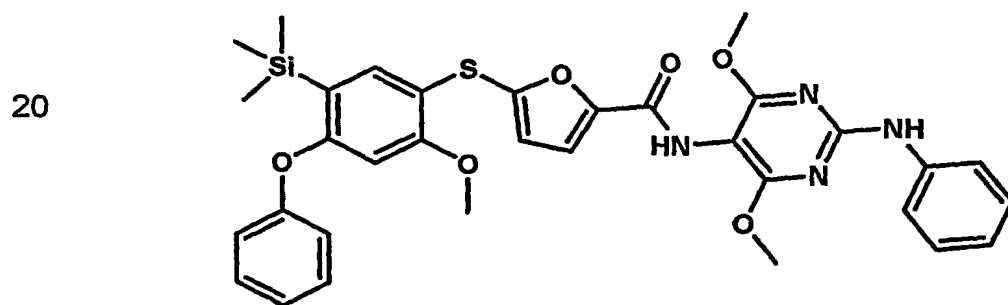
10 *N*-(2-chloro-4,6-dimethoxy-1,3-pyrimidin-5-yl)-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxyphenyl)-5-{2-methyl-4-[dimethyl(2,2-dimethylpropyl)silyl]phenoxy}furan-2-carboxamide;

N-(2,4,6-trimethoxyphenyl)-5-{2-methyl-4-[(1,1-dimethyl-2-trimethylsilyl)ethyl]phenoxy}furan-2-carboxamide; and

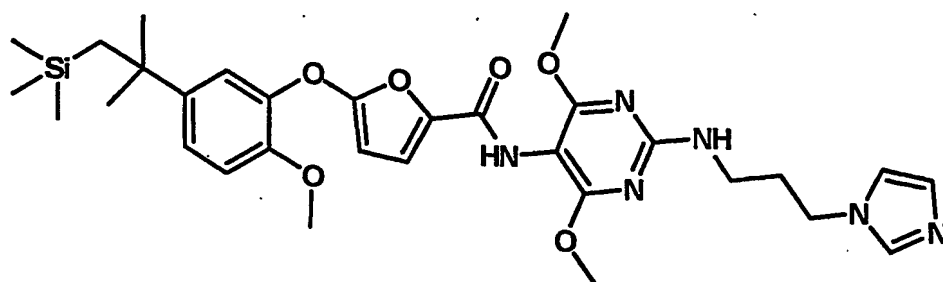
15 *N*-(2,4,6-trimethoxyphenyl)-5-(2-methyl-4,5-bis-trimethylsilylphenoxy)-furan-2-carboxamide;

the corresponding structures of which are shown below, respectively:

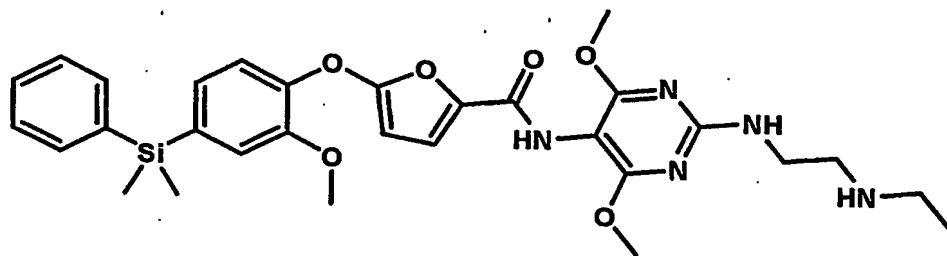


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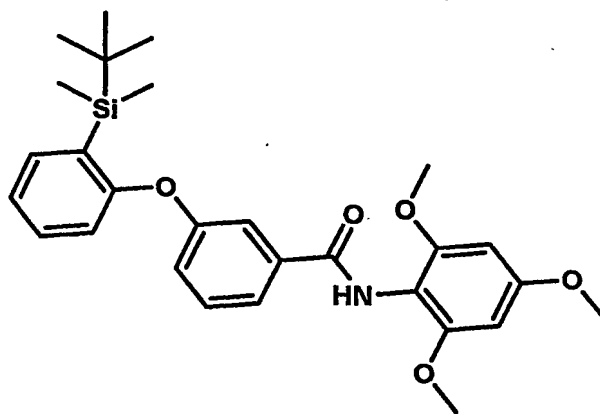
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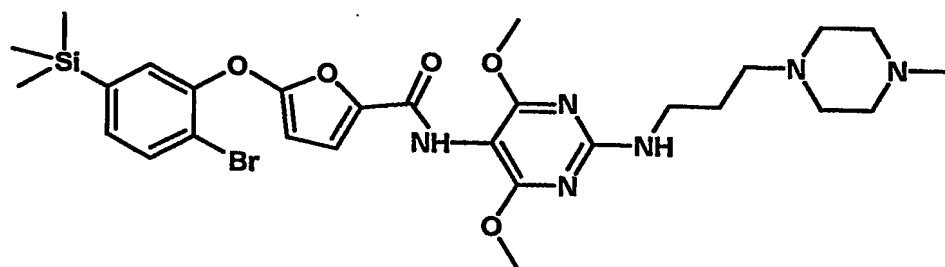
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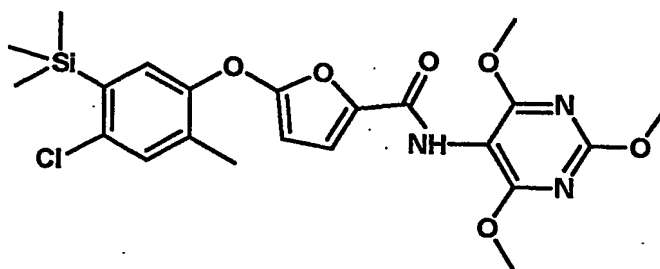


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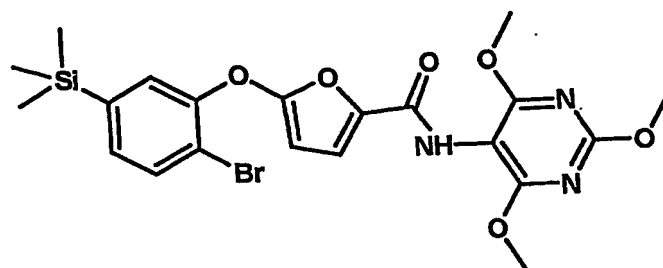


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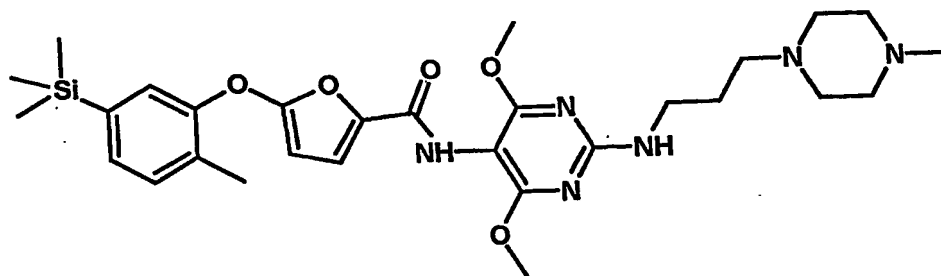
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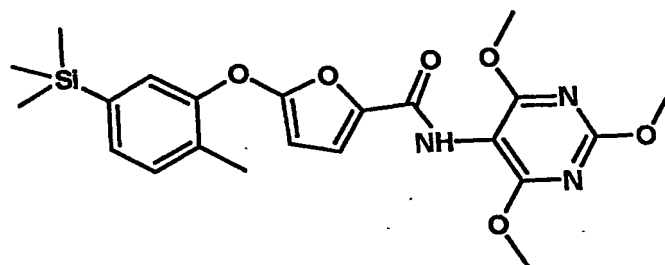
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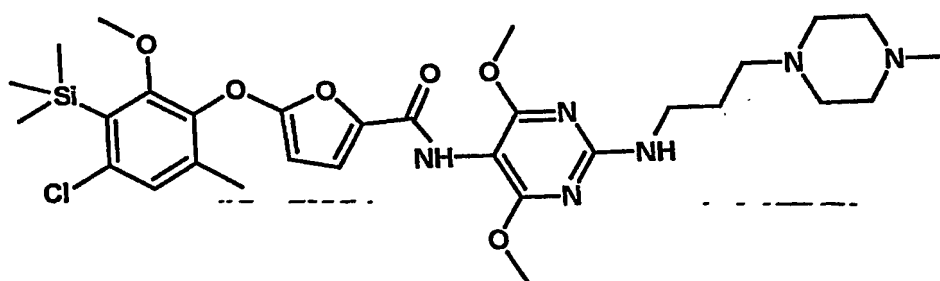


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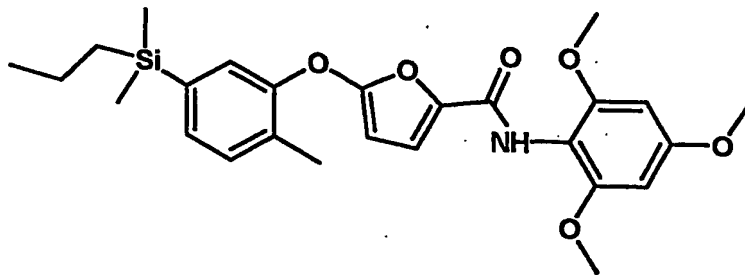
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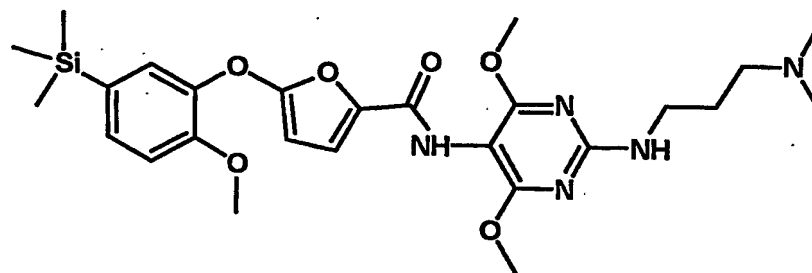


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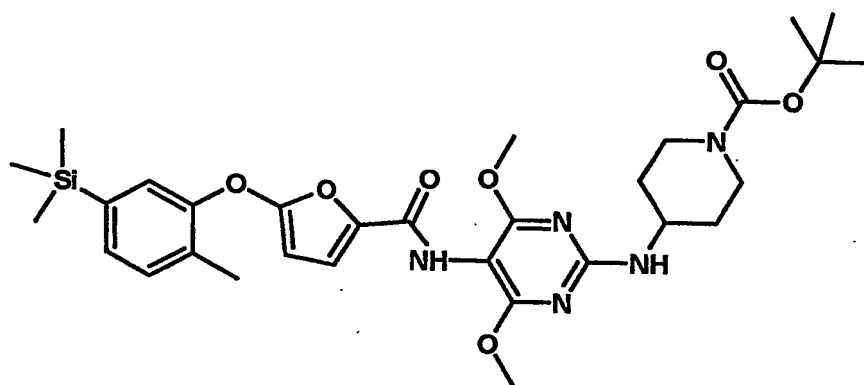
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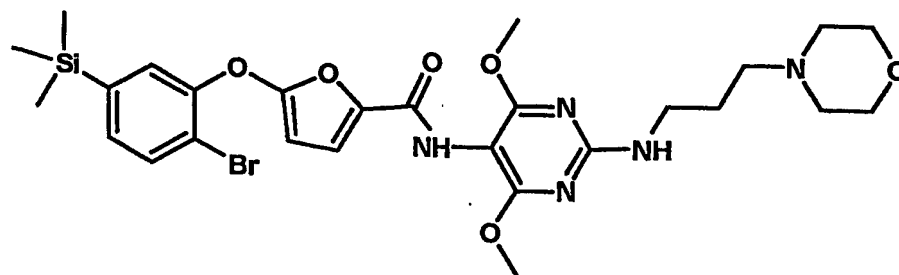
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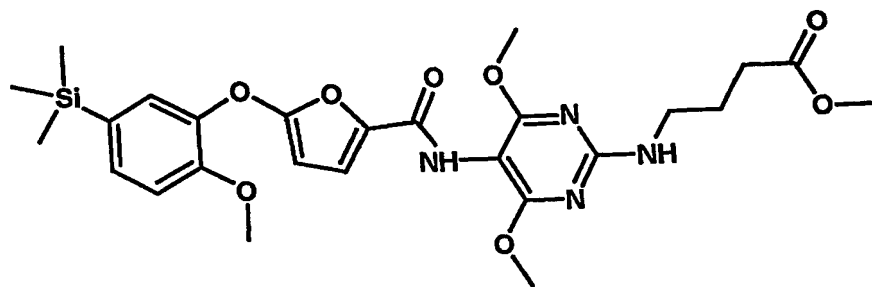


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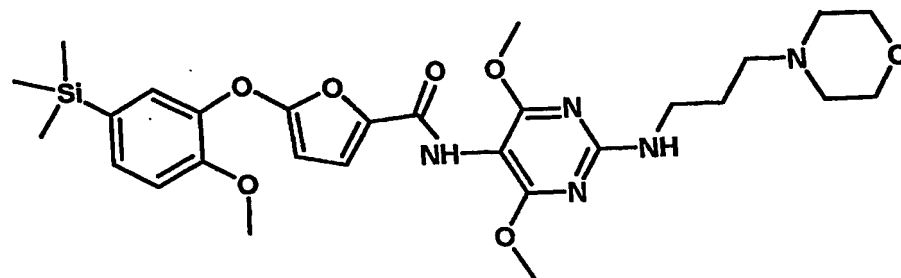
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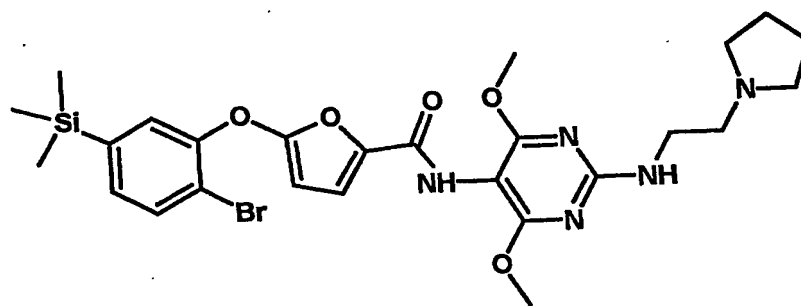
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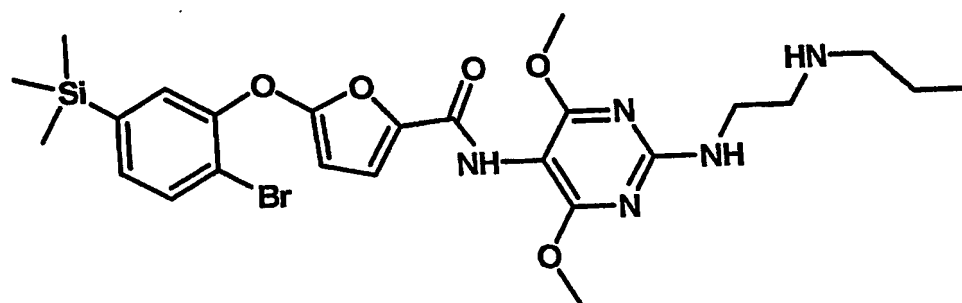
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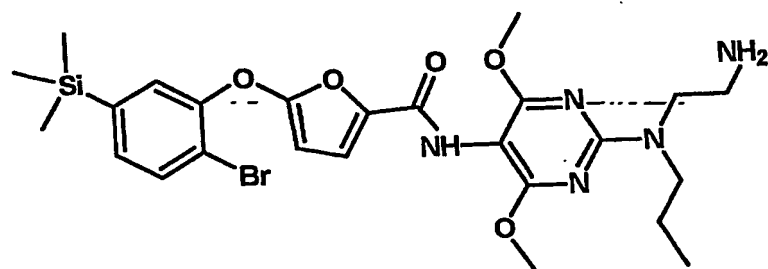


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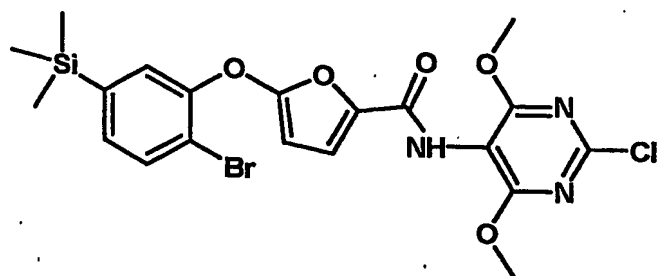
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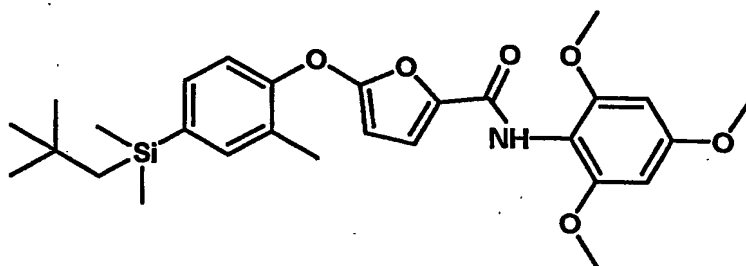


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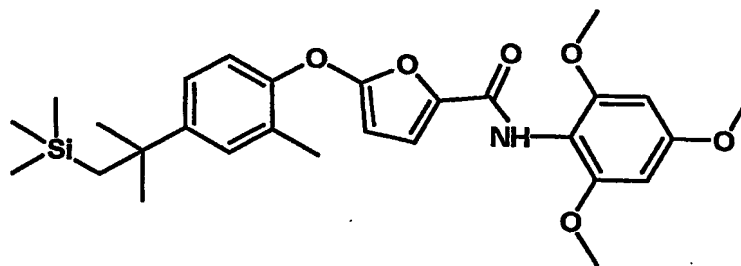
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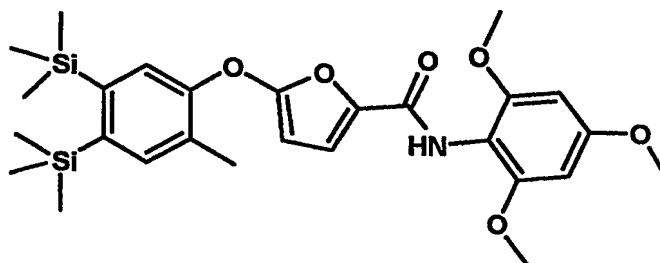


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Compounds of the invention may be chiral. They may be in the form of a single enantiomer or diastereomer, or a racemate.

The compounds of the invention may be prepared in racemic form, or prepared in individual enantiomeric form by specific synthesis or resolution as

will be appreciated in the art. The compounds may, for example, be resolved into their enantiomers by standard techniques, such as the formation of diastereomeric pairs by salt formation with an optically active acid followed by fractional crystallisation and regeneration of the free base. Alternatively, the enantiomers of the novel compounds may be separated by HPLC using a chiral column.

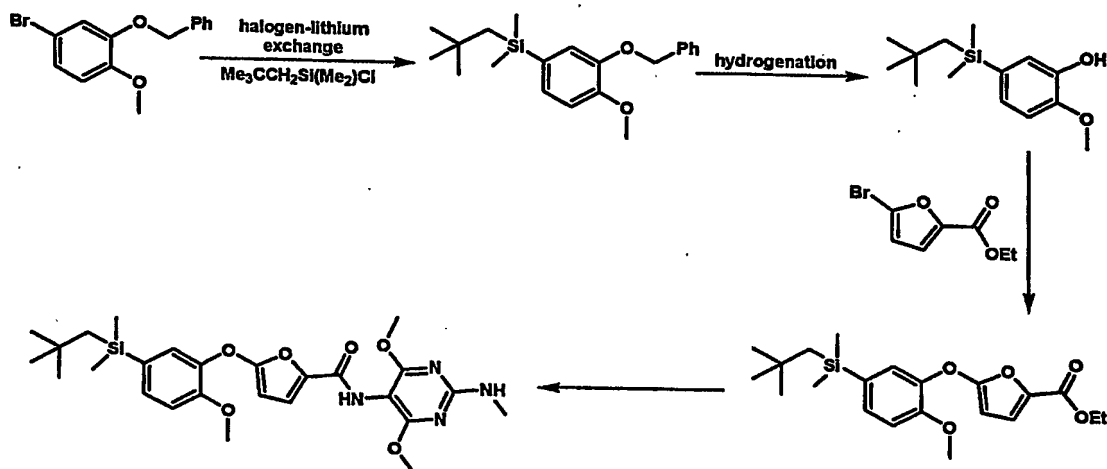
A compound of the invention may be in a protected amino, or protected hydroxy or protected carboxy form. The terms "protected amino", "protected hydroxy" and "protected carboxy" as used herein refer to amino, hydroxy and carboxy groups which are protected in a manner familiar to those skilled in the art. For example, an amino group can be protected by a benzyloxycarbonyl, tert-butoxycarbonyl, acetyl or like group, or in the form of a phthalimido or like group. A carboxyl group can be protected in the form of a readily cleavable ester such as the methyl, ethyl, benzyl or tert-butyl ester.

Some compounds of the formula may exist in the form of solvates, for example hydrates, which also fall within the scope of the present invention.

Compounds of the invention may be in the form of pharmaceutically acceptable salts, for example, addition salts of inorganic or organic acids. Such inorganic acid addition salts include, for example, salts of hydrobromic acid, hydrochloric acid, nitric acid, phosphoric acid and sulphuric acid. Organic acid addition salts include, for example, salts of acetic acid, benzenesulphonic acid, benzoic acid, camphorsulphonic acid, citric acid, 2-(4-chlorophenoxy)-2-methylpropionic acid, 1,2-ethanedisulphonic acid, ethanesulphonic acid, ethylenediaminetetraacetic acid (EDTA), fumaric acid, glucoheptonic acid, gluconic acid, glutamic acid, N-glycolylarsanilic acid, 4-hexylresorcinol, hippuric acid, 2-(4-hydroxybenzoyl)benzoic acid, 1-hydroxy-2-naphthoic acid, 3-hydroxy-2-naphthoic acid, 2-hydroxyethanesulphonic acid, lactobionic acid, n-dodecyl sulphuric acid, maleic acid, malic acid, mandelic acid, methanesulphonic acid, methyl sulphuric acid, mucic acid, 2-naphthalenesulphonic acid, pamoic acid, pantothenic acid, phosphanilic acid ((4-aminophenyl)phosphonic acid), picric acid, salicylic acid, stearic acid, succinic acid, tannic acid, tartaric acid, terephthalic acid, p-toluenesulphonic acid, 10-undecenoic acid and the like.

It will be appreciated that such salts, provided that they are pharmaceutically acceptable, may be used in therapy. Such salts may be prepared by reacting the compound with a suitable acid in a conventional manner.

- 5 A compound of the invention may be prepared by any suitable method known in the art and/or by the following process:



- It will be understood that the process detailed above is solely for the purpose of illustrating the invention and should not be construed as limiting. A process utilising similar or analogous reagents and/or conditions known to one skilled in the art may also be used to obtain a compound of the invention.

- Any mixtures of final products or intermediates obtained can be separated on the basis of the physico-chemical differences of the constituents, in a known manner, into the pure final products or intermediates, for example by chromatography, distillation, fractional crystallisation, or by the formation of a salt if appropriate or possible under the circumstances.

The activity and selectivity of the compounds may be determined by any suitable assay known in the art.

- The compounds of the invention may be used in the treatment of numerous ailments, conditions and diseases including, but not limited thereto, cancer, endometriosis, uterine myoma, an ovarian disease, a mammary cystic disease, prostatic hypertrophy, amenorrhea, precocious puberty, premenstrual

syndrome, a sex-steroid-dependent pathophysiology or benign prostatic hyperplasia, or to arrest spermatogenesis.

The term "cancer" as used herein refers to any disease or condition characterised by uncontrolled, abnormal growth of cells and includes all known
5 types of cancer, for example cancer of the bladder, breast, colon, brain, bone, head, blood, eye, neck, skin, lungs, ovaries, prostate and rectum; digestive, gastrointestinal, endometrial, hematological, AIDS-related, muscoskeletal, neurological and gynecological cancers; lymphomas, melanomas and leukemia.

In therapeutic use, the active compound may be administered orally,
10 rectally, intra-vaginally, parenterally, by inhalation (pulmonary delivery), topically, ocularly, nasally, or to the buccal cavity. Oral administration is preferred. Thus, the therapeutic compositions of the present invention may take the form of any of the known pharmaceutical compositions for such methods of administration. The compositions may be formulated in a manner known to
15 those skilled in the art so as to give a controlled release, for example rapid release or sustained release, of the compounds of the present invention. Pharmaceutically acceptable carriers suitable for use in such compositions are well known in the art. The compositions of the invention may contain 0.1-99% by weight of active compound. The compositions of the invention are generally
20 prepared in unit dosage form. Preferably, a unit dose comprises the active ingredient in an amount of 1-500 mg. The excipients used in the preparation of these compositions are the excipients known in the art.

Appropriate dosage levels may be determined by any suitable method known to one skilled in the art. It will be understood, however, that the specific
25 dose level for any particular patient will depend upon a variety of factors including the activity of the specific compound employed, the age, body weight, general health, sex, diet, time of administration, route of administration, rate of excretion, drug combination and the severity of the disease undergoing treatment.

30 Compositions for oral administration are preferred compositions of the invention and there are known pharmaceutical forms for such administration, for example tablets, capsules, granules, syrups and aqueous or oily suspensions.

The pharmaceutical composition containing the active ingredient may be in a form suitable for oral use, for example, as tablets, troches, lozenges, aqueous or oily suspensions, dispersible powders or granules, emulsions, hard or soft capsules, or syrups or elixirs. Compositions intended for oral use may be prepared according to any method known to the art for the manufacture of pharmaceutical compositions, and such compositions may contain one or more agents selected from the group consisting of sweetening agents, flavouring agents, colouring agents and preserving agents in order to provide pharmaceutically elegant and palatable preparations. Tablets contain the active ingredient in admixture with non-toxic pharmaceutically acceptable excipients which are suitable for the manufacture of tablets. These excipients may be, for example, inert diluents, such as calcium carbonate, sodium carbonate, lactose, calcium phosphate or sodium phosphate; granulating and disintegrating agents, for example corn starch or alginic acid; binding agents, for example starch, gelatin, acacia, microcrystalline cellulose or polyvinyl pyrrolidone; and lubricating agents, for example magnesium stearate, stearic acid or talc. The tablets may be uncoated or they may be coated by known techniques to delay disintegration and absorption in the gastrointestinal tract and thereby provide a sustained action over a longer period. For example, a time delay material such as glyceryl monostearate or glyceryl distearate may be employed.

Formulations for oral use may also be presented as hard gelatin capsules wherein the active ingredient is mixed with an inert solid diluent, for example calcium carbonate, calcium phosphate or kaolin, or as soft gelatin capsules wherein the active ingredient is mixed with water or an oil medium, for example peanut oil, liquid paraffin or olive oil.

Aqueous suspensions contain the active materials in admixture with excipients suitable for the manufacture of aqueous suspensions. Such excipients are suspending agents, for example sodium carboxymethylcellulose, methylcellulose, hydroxypropylmethylcellulose, sodium alginate, polyvinyl pyrrolidone, gum tragacanth and gum acacia; dispersing or wetting agents may be a naturally occurring phosphatide, for example lecithin, or condensation products of an alkylene oxide with fatty acids, for example polyoxyethylene

stearate, or condensation products of ethylene oxide with long-chain aliphatic alcohols, for example heptadecaethyleneoxycetanol, or condensation products of ethylene oxide with partial esters derived from fatty acids, for example polyoxyethylene sorbitan monooleate. The aqueous suspensions may also
5 contain one or more preservatives, for example ethyl or n-propyl p-hydroxybenzoate, one or more colouring agents, one or more flavouring agents, and one or more sweetening agents, such as sucrose or saccharin.

Oily suspensions may be formulated by suspending the active ingredient in a vegetable oil, for example arachis oil, olive oil, sesame oil or coconut oil, or
10 in a mineral oil such as liquid paraffin. The oily suspensions may contain a thickening agent, for example beeswax, hard paraffin or cetyl alcohol. Sweetening agents, such as those set forth above, and flavouring agents may be added to provide a palatable oral preparation. These compositions may be preserved by the addition of an antioxidant such as ascorbic acid.

15 Dispersible powders and granules suitable for preparation of an aqueous suspension by the addition of water provide the active ingredient in admixture with a dispersing or wetting agent, suspending agent and one or more preservatives. Suitable sweetening, flavouring and colouring agents may also be present.

20 The pharmaceutical compositions of the invention may also be in the form of oil-in-water emulsions. The oily phase may be a vegetable oil, for example olive oil or arachis oil, or a mineral oil, for example liquid paraffin, or mixtures of these. Suitable emulsifying agents may be naturally occurring gums, for example gum acacia or gum tragacanth, naturally occurring phosphatides, for
25 example soya bean, lecithin, and esters or partial esters derived from fatty acids and hexitol anhydrides, for example sorbitan monooleate and condensation products of the said partial esters with ethylene oxide, for example polyoxyethylene sorbitan monooleate. The emulsions may also contain sweetening and flavouring agents.

30 Syrups and elixirs may be formulated with sweetening agents, for example glycerol, propylene glycol, sorbitol or sucrose. Such formulations may also contain a demulcent, a preservative and flavouring and colouring agents. The

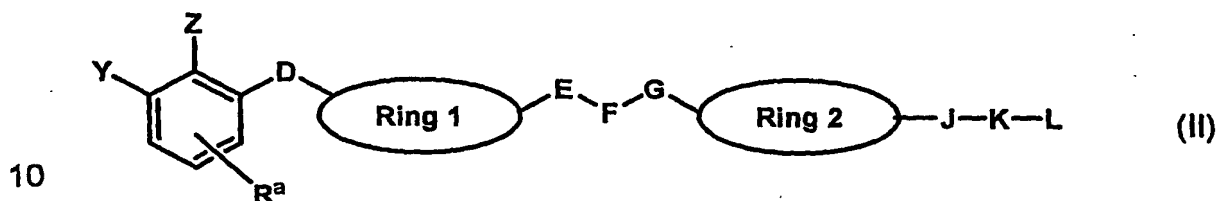
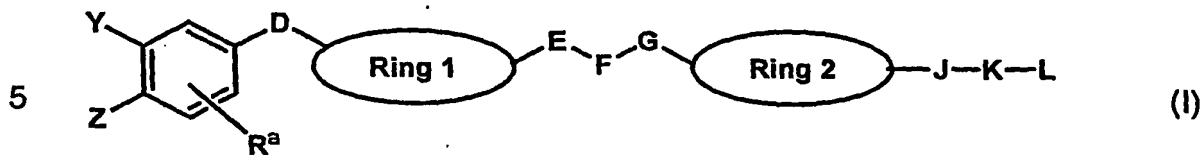
pharmaceutical compositions may be in the form of a sterile injectable aqueous or oleagenous suspension. This suspension may be formulated according to the known art using those suitable dispersing or wetting agents and suspending agents which have been mentioned above. The sterile injectable preparation may also be in a sterile injectable solution or suspension in a non-toxic parenterally acceptable diluent or solvent, for example as a solution in 1,3-butanediol. Among the acceptable vehicles and solvents that may be employed are water, Ringer's solution and isotonic sodium chloride solution. In addition, sterile, fixed oils are conventionally employed as a solvent or suspending medium. For this purpose, any bland fixed oil may be employed including synthetic mono- or diglycerides. In addition, fatty acids such as oleic acid, find use in the preparation of injectables.

The compounds of the invention may also be administered in the form of suppositories for rectal administration of the drug. These compositions can be prepared by mixing the drug with a suitable non-irritating excipient which is solid at ordinary temperatures but liquid at the rectal temperature and will therefore melt in the rectum to release the drug. Such materials are cocoa butter and polyethylene glycols.

Compositions for topical administration are also suitable for use in the invention. The pharmaceutically active compound may be dispersed in a pharmaceutically acceptable cream, ointment or gel. A suitable cream may be prepared by incorporating the active compound in a topical vehicle such as light liquid paraffin, dispersed in a aqueous medium using surfactants. An ointment may be prepared by mixing the active compound with a topical vehicle such as a mineral oil or wax. A gel may be prepared by mixing the active compound with a topical vehicle comprising a gelling agent. Topically administrable compositions may also comprise a matrix in which the pharmaceutically active compounds of the present invention are dispersed so that the compounds are held in contact with the skin in order to administer the compounds transdermally.

CLAIMS

1. A compound of formula (I) or formula (II)



wherein

D is $-(CH_2)_n-$, $-C(=X)-$, $-O-$, $-S(O)_m-$, $-C(=X)N(R^e)-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-C(R^b)=C(R^b)-$, $-CH(R^b)CH(R^b)-$;

15 E is optionally present and is $-(CH_2)_n-$, $-N(R^d)-$, $-(CH_2)_nN(R^d)-$ or $-N(R^d)(CH_2)_n-$;

F is $-C(=X)-$ or $-N(R^d)-$;

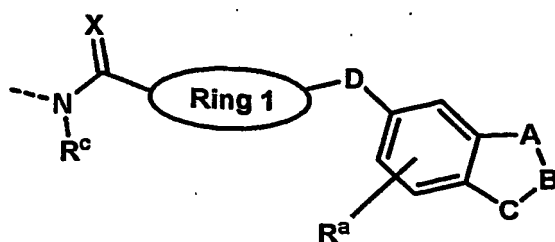
G is $-(CH_2)_n-$, $-N(R^d)-$, $-(CH_2)_nN(R^d)-$ or $-N(R^d)(CH_2)_n-$;

20 J is optionally present and is $-O-$, $-N(R^c)C(=X)-$, $-C(=X)N(R^c)-$, $-S(O)_m-$, $-N(R^c)S(O)_m-$, $-S(O)_mN(R^c)-$ or $-N(R^e)-$;

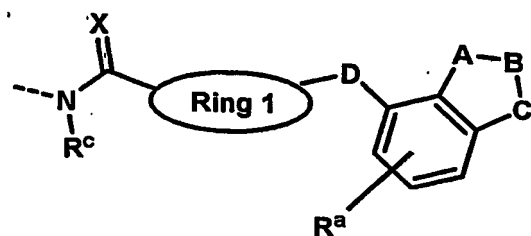
K is optionally present and is alkylene optionally substituted with R^b ; or K is cycloalkylene, cycloalkenylene, arylene, heterocycloalkylene, heterocycloalkylene or heteroarylene, any of which is optionally substituted with R^a ;

25 L is hydrogen, halogen, $-N(R^f)_2$, cycloalkyl, cycloalkenyl, aryl, heterocycloalkyl, heterocycloalkenyl or heteroaryl, any of which is optionally substituted with R^a , $-C(=X)OR^d$, $-OH$, $-OR^c$, $-C(=X)N(R^b)(R^c)$, $-S(O)_mN(R^b)(R^c)$ or $-CN$;

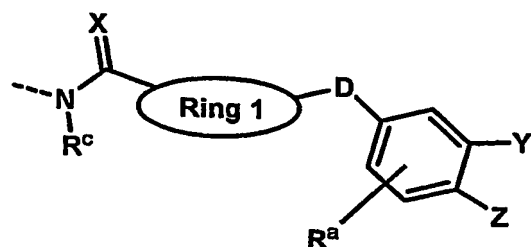
or L is a group of formula (i), (ii), (iii), or (iv)



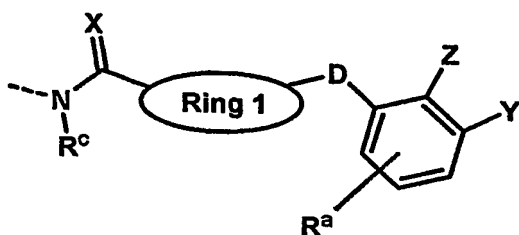
(i)



(ii)



(iii)



(iv)

A and C are the same or different and are each a bond, $-(CH_2)_n-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-O-$, $-S(O)_m-$, $-N=$, $-N(R^b)-$, $-N(R^e)C(=X)-$ or $-C(=X)-$;

B is $-(CH_2)_n-$, $-O-$, $-C(R^b)_2-$, $-Si(R^c)_2-$, $-C(R^b)=C(R^b)-$, $-C(R^b)=$, $-(CH_2)_nC(R^g)_2-$, $-C(R^g)_2(CH_2)_n-$ or $-CH(R^b)CH(R^b)-$;

N is nitrogen;

each R^a is the same or different and is hydrogen, halogen, alkyl, aryl, hydroxy, alkoxy, $-alkoxy-(CH_2)_nC(O)_2R^b$, $-O-aryl$, $-C(=X)R^c$, $-NO_2$, $-CN$, $-N(R^c)C(=X)R^c$, $-C(=X)N(R^c)_2$, $-S(O)_2N(R^c)_2$ or $-N(R^e)_2$;

each R^b is the same or different and is hydrogen or alkyl;

each R^c is the same or different and is alkyl, cycloalkyl, $-alkyl-aryl$, $-alkyl-cycloalkyl$ or aryl optionally substituted with R^a ;

each R^d is the same or different and is hydrogen, alkyl or aryl optionally with R^a ;

each R^e is the same or different and is hydrogen, alkyl; or R^e is aryl or heteroaryl, either of which is optionally substituted with R^a ;

5 each R^f is the same or different and is hydrogen or alkyl; or R^f -N- R^f taken together form heterocycloalkyl, heterocycloalkenyl or heteroaryl;

R^g -C- R^g taken together form heterocyclyl;

each X is the same or different and is oxygen or sulphur;

10 Y and Z are the same or different and are each hydrogen, halogen, alkyl, hydroxy, alkoxy, -CN, -N(R^d)C(=X) R^e , -C(=X)N(R^e)(R^d), -S(O)_m- R^e , -N(R^e)(R^d)S(O)₂, -S(O)₂N(R^e)(R^d), -N(R^e)₂, -Si(R^e)₃, -alkyl-Si(R^e)₃, aryl optionally substituted with R^a or -O-aryl optionally substituted with R^a ;

Rings 1 and 2 are the same or different and are each arylene or heteroarylene, either of which is optionally substituted with R^a ;

15 each m is the same or different and is 0, 1 or 2; and

each n is the same or different and is 0, 1, 2, or 3;

with the provisos that at least one of A, B, C, Y or Z comprises silicon and that the compound does not comprise a Si-Si bond; or a pharmaceutically acceptable salt thereof.

20 2. A compound according to claim 1, wherein Y is -Si(R^e)₃, -alkyl-Si(R^e)₃ or hydrogen.

3. A compound according to claim 2, wherein each R^e is the same or different and is alkyl.

4. A compound according to any preceding claim, wherein Z is -Si(R^e)₃,
25 -alkyl-Si(R^e)₃, -O-aryl or hydrogen.

5. A compound to claim 4, wherein each R^e is the same or different and is alkyl or phenyl.

6. A compound according to any preceding claim, wherein R^a is alkyl, halogen or alkoxy.

30 7. A compound according to any preceding claim, wherein D is oxygen, sulphur or -CH₂-.

8. A compound according to any preceding claim, wherein E is absent.

9. A compound according to any preceding claim, wherein F is -C(O)-.
10. A compound according to any preceding claim, wherein G is -N(R^d)-.
11. A compound according to claim 10, wherein R^d is hydrogen.
12. A compound according to any preceding claim, wherein J and K are
5 absent, and L is hydrogen.
13. A compound according to any of claims 1 to 11, wherein J is -NH-, K is alkyl and L is heterocycloalkyl.
14. A compound according to any preceding claim, wherein Ring 1 is heteroaryl.
- 10 15. A compound according to claim 14, wherein Ring 1 is furanylene or oxazolylen.
16. A compound according to any of claims 1 to 13, wherein Ring 1 is phenylene.
17. A compound according to any preceding claim, wherein Ring 2 is
15 phenylene, pyrimidylene or pyridinylen, any of which is optionally substituted.
18. A compound according to claim 17, wherein Ring 2 is substituted 1,2 or 3 times, the substituents being the same or different in each occurrence and selected from alkoxy and halogen.
19. A compound according to claim 1, selected from:
20 *N*-{[2-(phenylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(6-methoxy-4-phenoxy-3-trimethylsilylphenylthio)}furan-2-carboxamide;
N-{[2-(*N*-*tert*-butyloxycarboxypiperidinyl-4'-amino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-5-((2,2-dimethylpropyl)dimethylsilyl)phenoxy]}furan-2-carboxamide;
25 *N*-{[2-(3-imidazalo-*N*-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-5-(1,1-dimethyl-2-trimethylsilylethyl)phenoxy]}furan-2-carboxamide;
N-{[2-(2-ethylaminoethylamine)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-[2-methoxy-4-(dimethylphenylsilyl)phenoxy]}furan-2-carboxamide;
30 *N*-{[(2,4,6-trimethoxyphenyl)-5-[2-(*tert*-butyldimethylsilyl)phenyloxy]}phenyl-2-carboxamide;
N-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(4-chloro-2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

5 *N*-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxy-1,3-pyrimidin-5-yl)-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

10 *N*-[2-(*N*-methylpiperazinyl-3-propylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(4-chloro-2-methoxy-6-methyl-3-trimethylsilylphenoxy)furan-2-carboxamide.

N-(2,4,6-trimethoxyphenyl)-5-[2-methyl-(5-dimethylpropylsilyl)phenoxy]furan-2-carboxamide;

N-[2-(3-dimethylamino-propylamino)]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

15 *N*-{2-[(*N*-tert-butoxycarbonylpiperidin-4-yl)amino]}-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methyl-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(3-morpholinylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

20 *N*-[2-(3-methoxycarbonylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(3-morpholinylpropylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-methoxy-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-[2-(2-pyrrolidinylethylamino)-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

25 *N*-{[2-(2-(ethylamino)ethylamino)]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide};

N-[2-[*N*-(2-aminoethyl)-propylamino]]-4,6-dimethoxy-1,3-pyrimidin-5-yl]-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

30 *N*-(2-chloro-4,6-dimethoxy-1,3-pyrimidin-5-yl)-5-(2-bromo-5-trimethylsilylphenoxy)furan-2-carboxamide;

N-(2,4,6-trimethoxyphenyl)-5-{2-methyl-4-[dimethyl(2,2-dimethylpropyl)silyl]phenoxy}furan-2-carboxamide;

N-(2,4,6-trimethoxyphenyl)-5-{2-methyl-4-[(1,1-dimethyl-2-trimethylsilyl)-ethyl]phenoxy}furan-2-carboxamide; and

N-(2,4,6-trimethoxyphenyl)-5-(2-methyl-4,5-bis-trimethylsilylphenoxy)-furan-2-carboxamide.

- 5 20. A compound according to any preceding claim, which is in the form of a single enantiomer or diastereomer.
21. A compound according to any preceding claim, for therapeutic use.
22. A pharmaceutical composition comprising a compound of any of claims 1 to 20 and a pharmaceutically acceptable diluent or carrier.
- 10 23. Use of a compound of any of claims 1 to 20, for the manufacture of a medicament for cancer therapy.
24. Use of a compound of any of claims 1 to 20, for the manufacture of a medicament for the treatment or prevention of endometriosis, uterine myoma, an ovarian disease, a mammary cystic disease, prostatic hypertrophy, amenorrhea,
- 15 precocious puberty, premenstrual syndrome, a sex-steroid-dependent pathophysiology or benign prostatic hyperplasia, or to arrest spermatogenesis.
25. Use according to claim 24, for the treatment or prevention of endometriosis with pain, polycystic ovarian disease or secondary amenorrhea.

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